

Claims

1. In an external pressure vessel providing protection from external pressure in an undersea environment to a hermetically sealed optical amplifier module located therein, said hermetically sealed module comprising:

at least one optical amplifier;

an hermetically sealed housing for containing therein said at least one optical amplifier, said housing having a retaining element for retaining the housing within the external pressure vessel;

a plurality of ports for conveying into the housing, in an hermetically sealed manner, at least one optical fiber and a conductor incorporated in an undersea optical fiber cable, said conductor supplying electrical power to the optical amplifier; and

at least one conductive terminal located in the housing for establishing electrical contact with the conductor traversing each of the plurality of ports, said conductive terminal supplying electrical power from the conductor to said at least one optical amplifier.

2. The hermetically sealed module of claim 1 further comprising a pressure seal located between each of the ports and the conductor.

3. The hermetically sealed module of claim 2 wherein said pressure seal is a polyethylene seal.

4. The hermetically sealed module of claim 1 wherein said undersea optical fiber cable further comprises an electrically insulating sheath surrounding the optical fiber and the conductor, said pressure seal being located between the port and the electrically insulating sheath.

5. The hermetically sealed module of claim 1 wherein said conductive terminal includes a through hole traversed by said at least one optical fiber.

6. The hermetically sealed module of claim 5 further comprising a ferrule located in the through hole, said ferrule being traversed by said at least one optical fiber and providing a hermetic seal therewith.

7. The hermetically sealed module of claim 1 wherein an end portion of said at least one optical fiber includes a metallized coating for soldering said optical fiber within the housing.

8. The hermetically sealed module of claim 6 wherein an end portion of said at least one optical fiber includes a metallized coating for soldering said optical fiber within the housing.

9. The hermetically sealed module of claim 1 wherein said retaining element comprises an adjustable expansion mechanism located on an outer surface of the housing for exerting pressure against an inner wall of the pressure vessel so that the housing is retained therein.

10. The hermetically sealed module of claim 9 wherein said adjustable expansion mechanism includes a plurality of pivotable members.

11. The hermetically sealed module of claim 10 wherein said adjustable expansion mechanism includes an alignment member for aligning the housing within the pressure vessel.

12. The hermetically sealed module of claim 11 wherein said alignment member is selected from the group consisting of a boss, tab, tang and slot.

13. The hermetically sealed module of claim 11 wherein said adjustable expansion mechanism provides continuous indexing variability.

14. The hermetically sealed module of claim 1 further comprising a gas fill port extending into the housing for supplying gas to an interior of the housing.

15. The hermetically sealed module of claim 1 further comprising a fiber tray located in the housing for supporting optical fiber employed in the optical amplifier.

16. The hermetically sealed module of claim 1 further comprising a plurality of receptacles sized to receive a passive optical component employed in the optical amplifier.

17. The hermetically sealed module of claim 15 further comprising a plurality of receptacles sized to receive a passive optical component employed in the optical amplifier.

18. The hermetically sealed module of claim 17 wherein said plurality of receptacles are integrally formed with said fiber tray.

19. The hermetically sealed module of claim 1 wherein said optical amplifier includes a circuit board located in the housing.

20. The hermetically sealed module of claim 19 wherein said optical amplifier includes at least one optically active element mounted to the circuit board.

21. The hermetically sealed module of claim 20 wherein said at least one optical amplifier comprises a rare-earth doped optical amplifier.

22. The hermetically sealed module of claim 21 wherein said rare-earth doped optical amplifier includes a rare-earth doped fiber for imparting gain to an optical signal propagating therethrough, a pump source for supplying pump power to the rare-earth doped fiber, and a coupler for coupling the pump power to the rare-earth doped fiber, said rare-earth doped fiber and said coupler each residing in one of the plurality of receptacles.

23. The hermetically sealed module of claim 1 wherein said at least one optical amplifier comprises a plurality of optical amplifiers.

24. In an external pressure vessel providing protection from external pressure in an undersea environment to a hermetically sealed module located therein, said hermetically sealed module comprising:

an hermetically sealed housing for containing therein at least one electrical component to which an optical signal is communicated, said housing having a retaining element for retaining the housing within the external pressure vessel;

a plurality of ports for conveying into the housing, in an hermetically sealed manner, at least one optical fiber through which the optical signal is transmitted and a conductor incorporated in an undersea optical fiber cable, said conductor supplying electrical power to said at least one electrical component; and

at least one conductive terminal located in the housing for establishing electrical contact with the conductor traversing each of the plurality of ports.

25. The hermetically sealed module of claim 24 further comprising a pressure seal located between each of the ports and the conductor.

26. The hermetically sealed module of claim 25 wherein said pressure seal is a polyethylene seal.

27. The hermetically sealed module of claim 24 wherein said undersea optical fiber cable further comprises an electrically insulating sheath surrounding the optical fiber and the conductor, said pressure seal being located between the port and the electrically insulating sheath.

28. The hermetically sealed module of claim 24 wherein said conductive terminal includes a through hole traversed by said at least one optical fiber.

29. The hermetically sealed module of claim 28 further comprising a ferrule located in the through hole, said ferrule being traversed by said at least one optical fiber and providing a hermetic seal therewith.

30. The hermetically sealed module of claim 24 wherein an end portion of said at least one optical fiber includes a metallized coating for soldering said optical fiber within the housing.

31. The hermetically sealed module of claim 29 wherein an end portion of said at least one optical fiber includes a metallized coating for soldering said optical fiber within the housing.

32. The hermetically sealed module of claim 24 wherein said retaining element comprises an adjustable expansion mechanism located on an outer surface of the housing for exerting pressure against an inner wall of the pressure vessel so that the housing is retained therein.

33. The hermetically sealed module of claim 32 wherein said adjustable expansion mechanism includes a plurality of pivotable members.

34. The hermetically sealed module of claim 33 wherein said adjustable expansion mechanism includes an alignment member for aligning the housing within the pressure vessel.

35. The hermetically sealed module of claim 34 wherein said alignment member is selected from the group consisting of a boss, tab, tang and slot.

36. The hermetically sealed module of claim 34 wherein said adjustable expansion mechanism provides continuous indexing variability.

37. The hermetically sealed module of claim 24 further comprising a gas fill port extending into the housing for supplying gas to an interior of the housing.

38. The hermetically sealed module of claim 24 further comprising a fiber tray located in the housing for supporting optical fiber coupled to the electrical component.

39. The hermetically sealed module of claim 24 further comprising a plurality of receptacles sized to receive a passive component employed in the electrical component.

40. The hermetically sealed module of claim 38 further comprising a plurality of receptacles sized to receive a passive component employed in the electrical component.

41. The hermetically sealed module of claim 40 wherein said plurality of receptacles are integrally formed with said fiber tray.

42. The hermetically sealed module of claim 24 wherein said electrical component includes a circuit board located in the housing.

43. The hermetically sealed module of claim 42 wherein said electrical component includes at least one active element mounted to the circuit board.